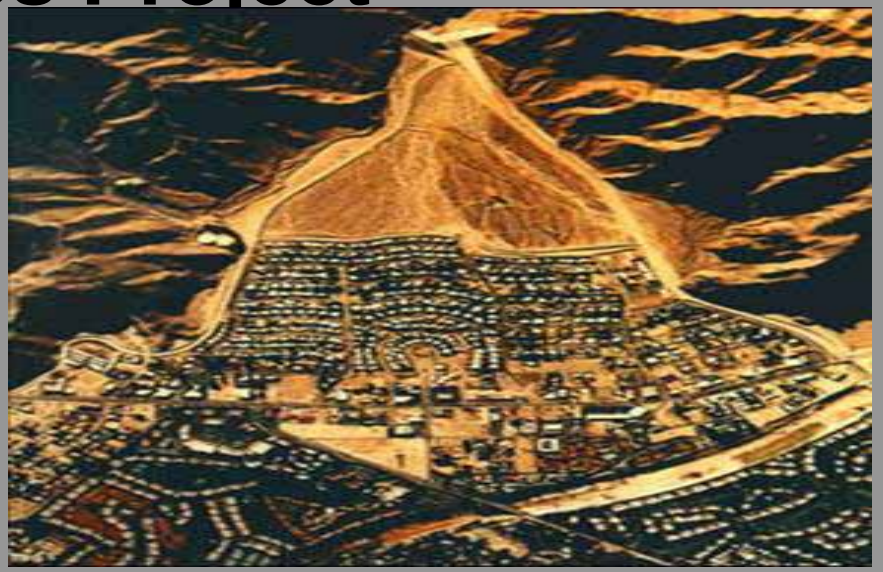
# Southern California's Alluvial Fan Floodplains

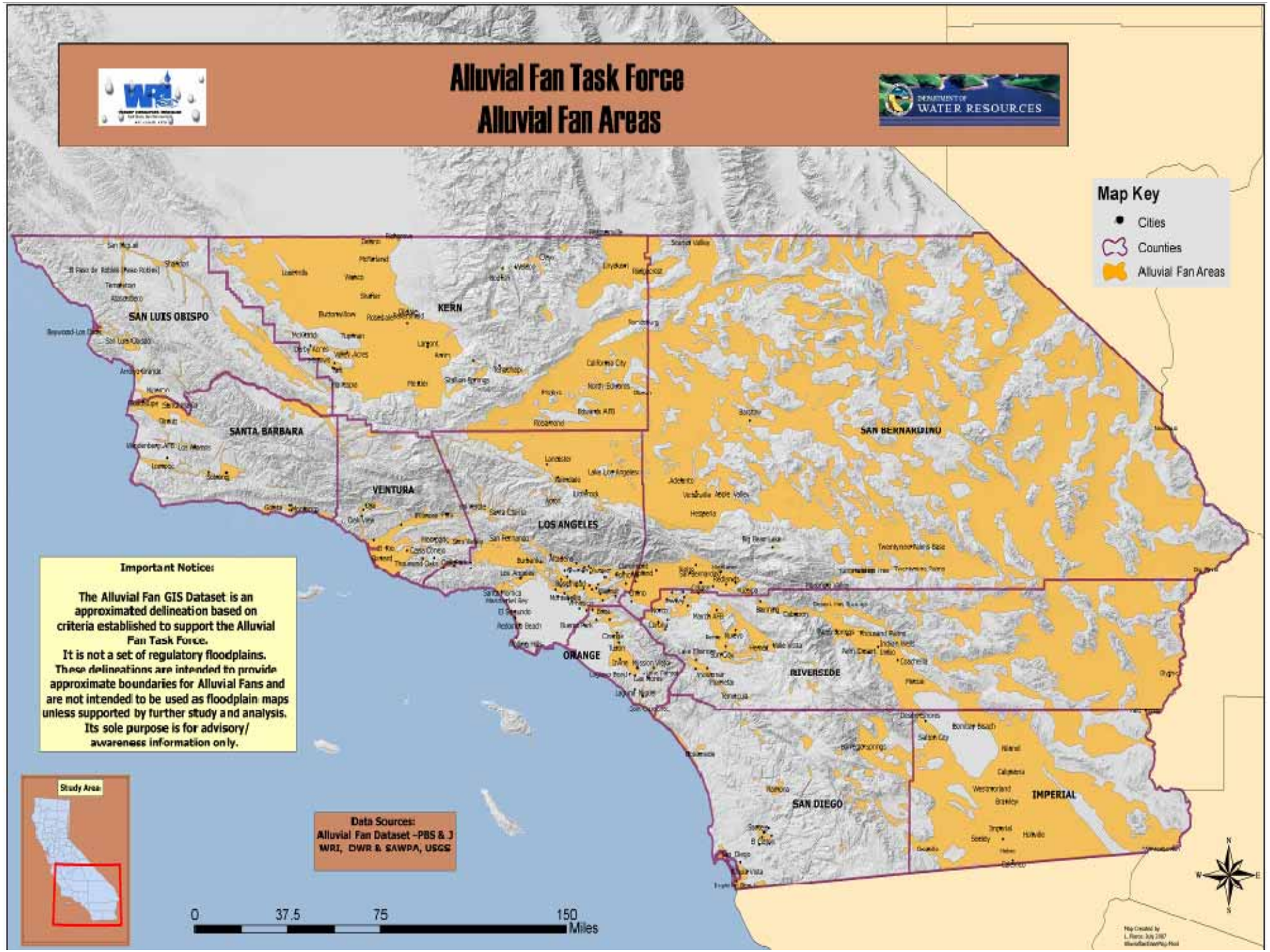
## Update of the Alluvial Fan Task Force

## A California Department of Water Resources Project



**Presentation to the**
**SCAG Water Policy Task Force**
**By**
**Task Force Coordinator**
**Susan Lien Longville**

Water Resources Institute
Cal State, San Bernardino

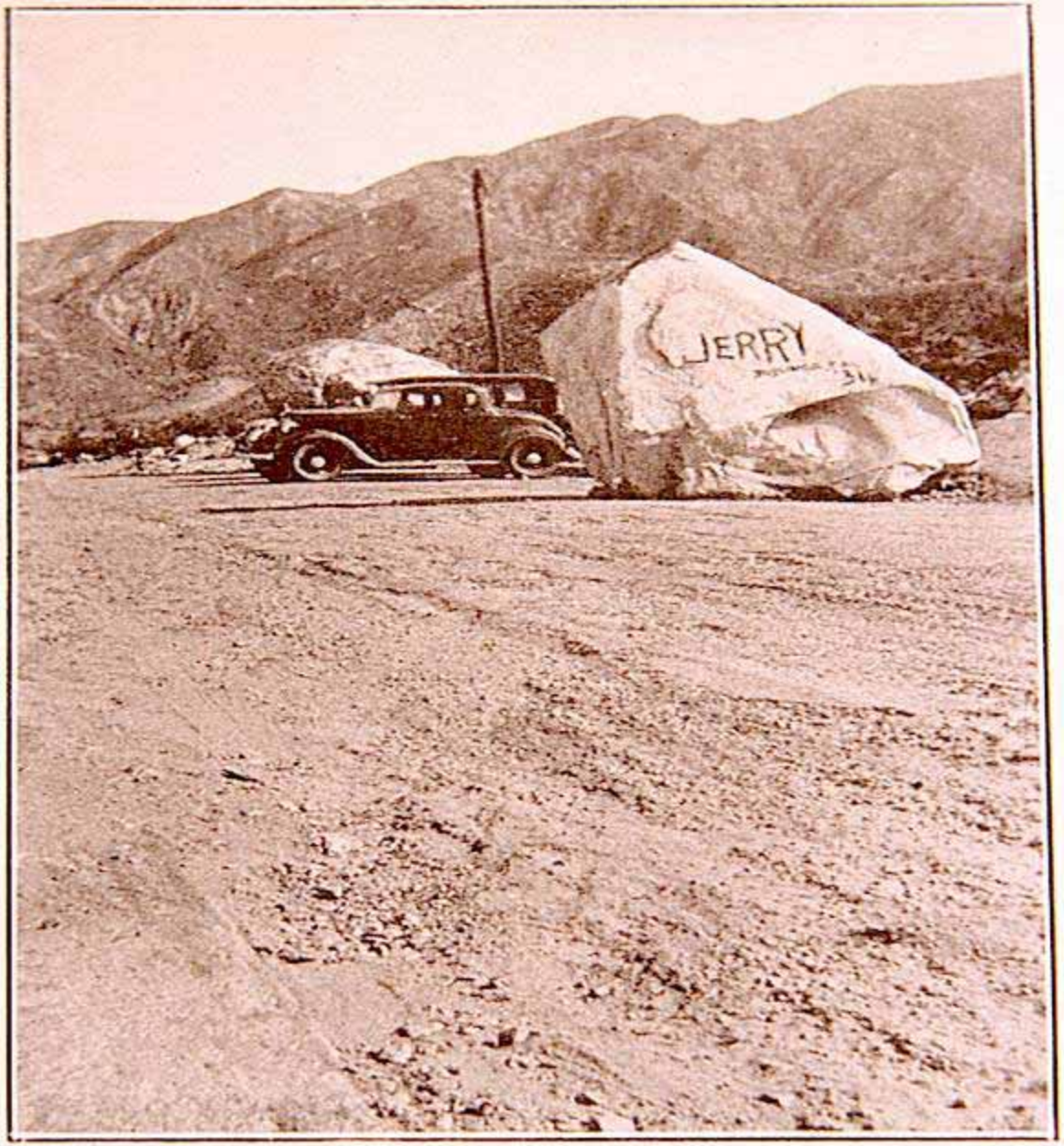

Alluvial Fan Task Force
Alluvial Fan Areas
DEPARTMENT OF WATER RESOURCES
Map Key
Cities
Counties
Alluvial Fan Areas
SAN LUIS OBISPO
KERN
SANTA BARBARA
VENTURA
LOS ANGELES
SAN BERNARDINO
ORANGE
RIVERSIDE
SAN DIEGO
IMPERIAL
Important Notice:
The Alluvial Fan GIS Dataset is an approximated delineation based on criteria established to support the Alluvial Fan Task Force.
It is not a set of regulatory floodplains.
These delineations are intended to provide approximate boundaries for Alluvial Fans and are not intended to be used as floodplain maps unless supported by further study and analysis.
Its sole purpose is for advisory/ awareness information only.
Study Area
Data Sources:
Alluvial Fan Dataset -PBS & J
WRI, DWR & SAWPA, USGS
0
37.5
75
150
Miles
N
S
E
W

# What Do Southern California's Floods Look Like?

- **Riverine: Just High Water**
- **Sediment-Laden Flooding**
  - Ash, clay, silt, sand, gravel, cobble, boulder
- **Debris Flooding**
  - Wood, cars, refrigerators, storage tanks, ….
- **Alluvial Flooding**
- **Coastal Flooding**

# SCAG Region Flood History Lesson

- Historical records indicate that large amounts of rain in a given year do not necessary trigger flooding
- Historical records suggest that Southern California has a history of periodic flooding on alluvial fans and downstream alluvial floodplains
- Historical records reveal that high-velocity, debris-laden flows on alluvial fans are often triggered by a series of storms following wildfires at higher elevations
- Historical records show that serious flooding can also be triggered by small isolated rain events
- Flooding on fans can cause major damage to structures not only on fans but also on downstream alluvial floodplains.




A. TWO BOULDERS ON PAVEMENT AT END OF NEW YORK AVENUE.

These boulders were brought down Dunsmore Creek by the flood. Estimated weight over 60 tons each.

# 1960's

- Housing and Urban Development Act of August 1968 Starts the National Flood Insurance Program (NFIP). P.L. 91-152, Sec. 409 (a)

- Concept: Costs of and benefits to those living at similar risk are shared across the entire Country and over time.

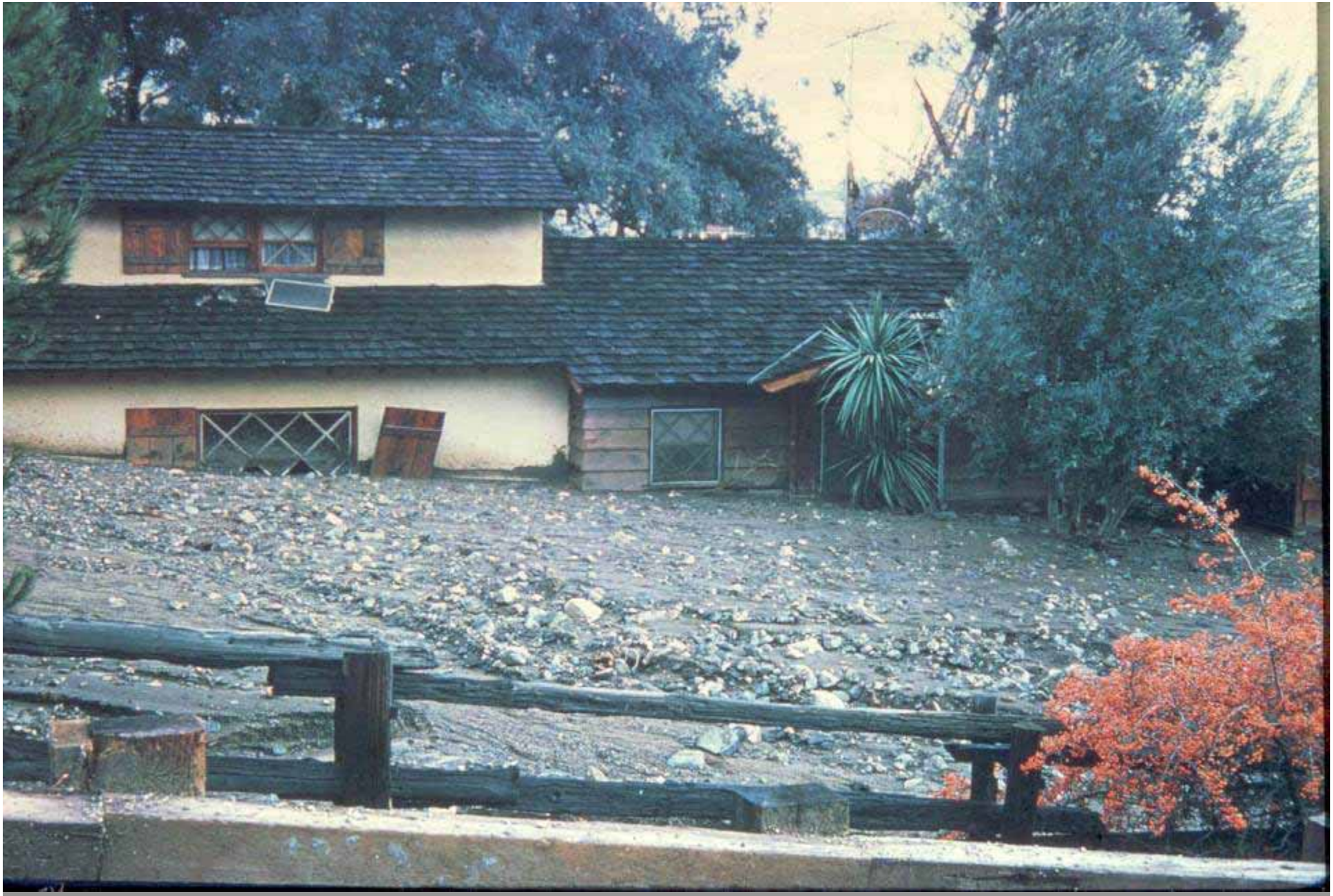
- Maps will show who is at risk.

# 1960's

- Excessive Rainfall, Hillside Development, and Wildfires trigger floods and debris flows in Los Angeles During the January 19, 1969 Storm.
- Debris Flows were generally called Mudslides in the news coverage.
- In the LA area, mudslides were generally considered to be a type of flood event.

# January 1969 Debris Flows in Old Topanga Canyon

FIGURE 27.—Hole punched through house of 975 Old Topanga Canyon Road, debris flow of January 25, 1969. Occupants reportedly escaped without injury. Soil-slip scar above house is shown in figure 3. Photograph by Department of the County Engineer, Los Angeles County.



**1969 post-fire debris flow in Glendora**

# 1970’s

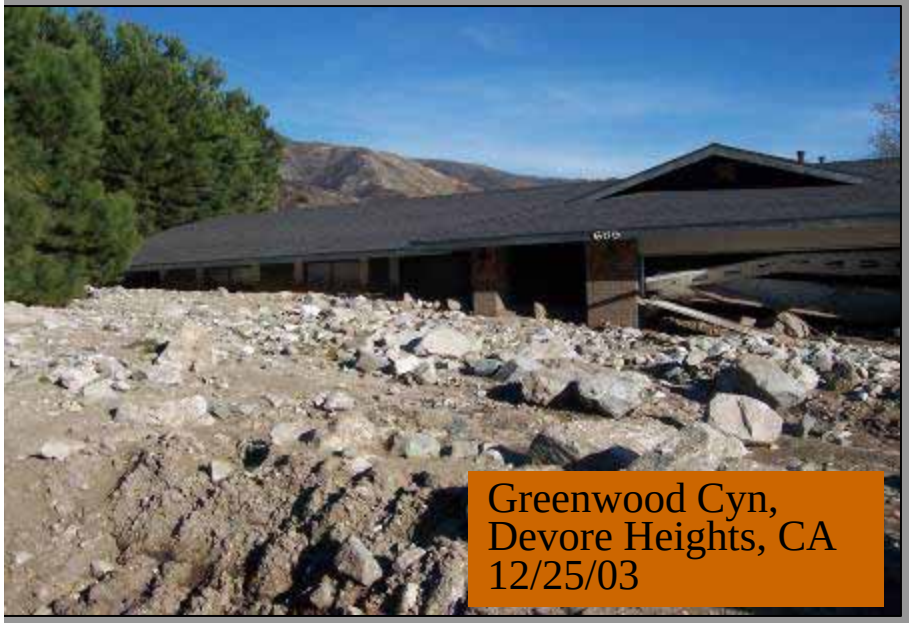
- FEMA focuses on mapping flood hazards on alluvial fan areas.
- Work commences on a new floodplain management ordinance for alluvial fans
- Many alluvial fan and other areas were mapped by FEMA during the late 1970’s

# 1980's

- More Floods
- On August 15, 1989, Section 59.1 of the NFIP regulations was modified to define "Alluvial Fan Flooding"
- Section 65.13 was also added. It outlined the requirements to remove an area from the "Alluvial Fan Flooding" zone.

# 2003 Post-fire Debris Flows


Waterman Canyon, 12/25/03


Greenwood Cyn, Devore Heights, CA 12/25/03


Cable Canyon, 12/25/03

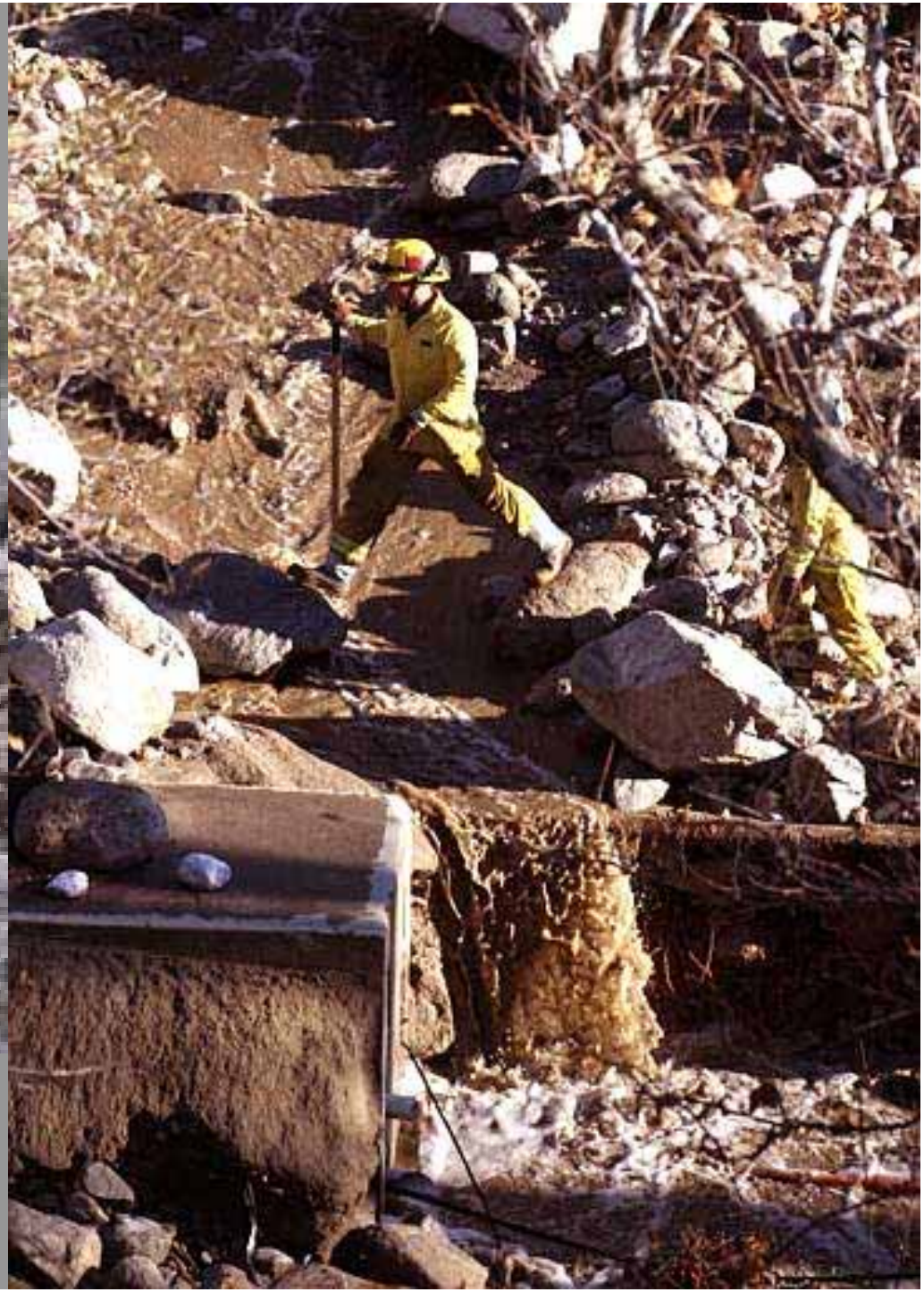
# Fire Behavior and Effects
## On
# Alluvial Fans

- There is “Stuff” in the Watersheds and Forests
- When it burns, the byproducts are carried down:
  - Uranium
  - Arsenic
  - Formaldehyde
  - Barium
  - Beryllium
  - Copper
  - Chromium
  - Cadmium
  - Lead
  - Zinc
  - Asbestos
  - Pesticides
  - Automobile products

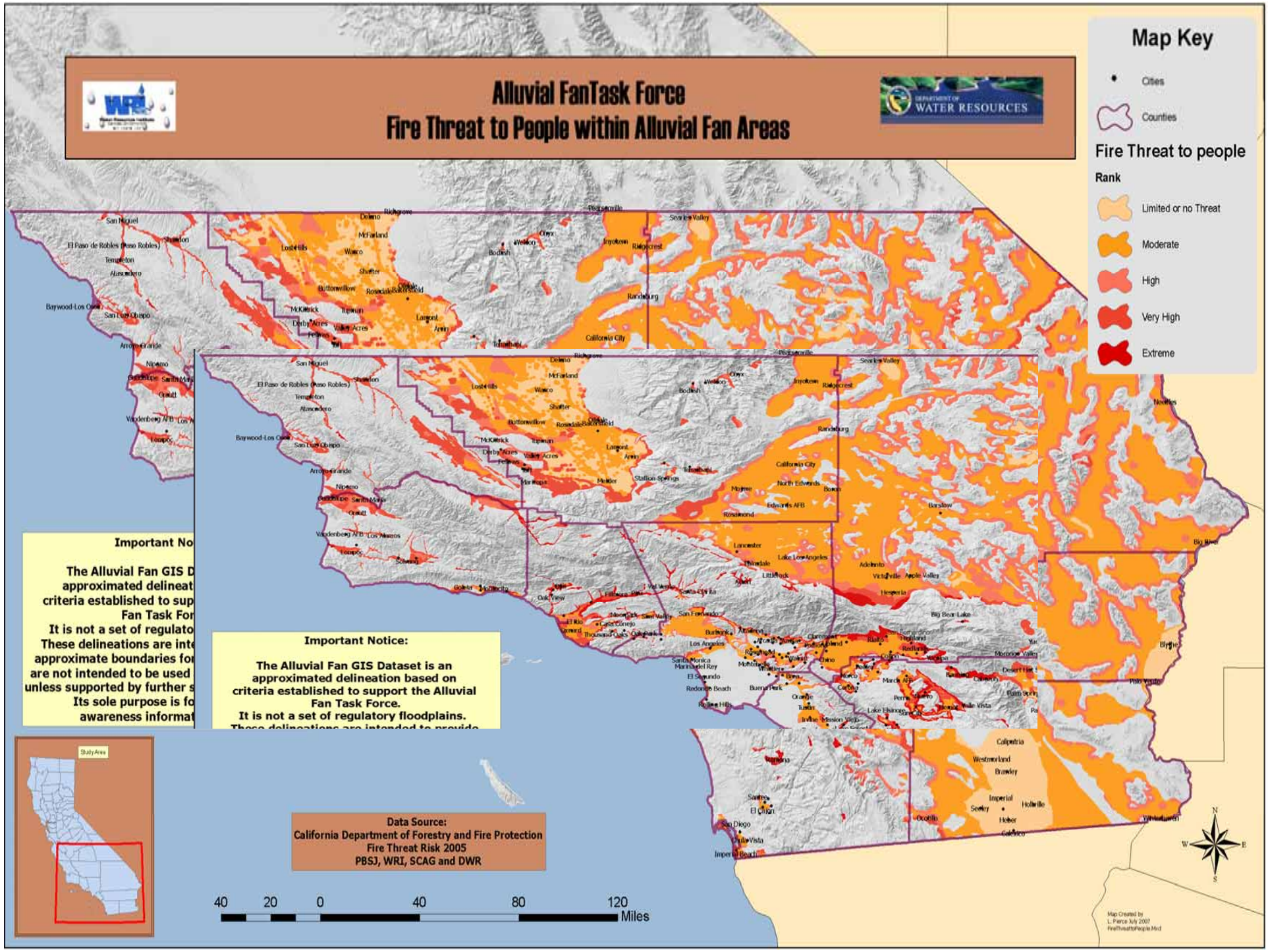
# Fire Behavior and Effects
On
# Alluvial Fans



- Fuels transition from grasses, to shrubs, to timber
- Energy Release Components generally increase
- Flame lengths and mid flame temperatures increase
- Fire intensity is dynamic and varies throughout the year
- Tactical opportunities change rapidly



# 2007
# More Wildfires at the Urban Interface


Alluvial FanTask Force
Fire Threat to People within Alluvial Fan Areas
DEPARTMENT OF WATER RESOURCES
Map Key
Cities
Counties
Fire Threat to people
Rank
Limited or no Threat
Moderate
High
Very High
Extreme
Important Notice:
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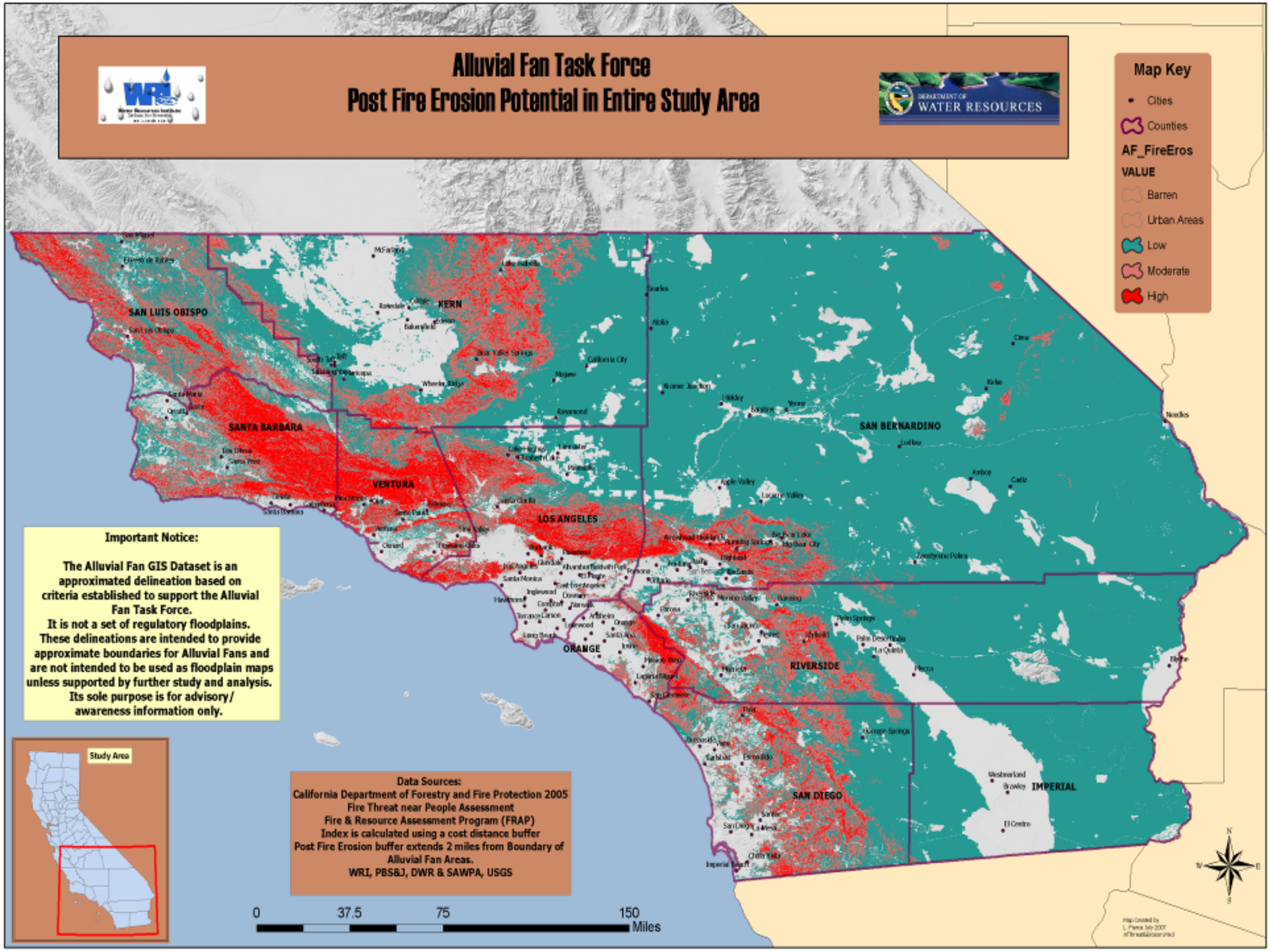
Data Source:
California Department of Forestry and Fire Protection
Fire Threat Risk 2005
PBSJ, WRI, SCAG and DWR
40 20 0 40 80 120
Miles
Study Area
N
W
E
S
Map Created by
L. Pierce July 2007
FireThreattoPeople.mxd


Alluvial Fan Task Force
Post Fire Erosion Potential in Entire Study Area
DEPARTMENT OF WATER RESOURCES
Map Key
Cities
Counties
AF_FireEros
VALUE
Barren
Urban Areas
Low
Moderate
High
SAN LUIS OBISPO
KERN
SANTA BARBARA
VENTURA
LOS ANGELES
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Study Area
Data Sources:
California Department of Forestry and Fire Protection 2005
Fire Threat near People Assessment
Fire & Resource Assessment Program (FRAP)
Index is calculated using a cost distance buffer
Post Fire Erosion buffer extends 2 miles from Boundary of Alluvial Fan Areas.
WRI, PBS&J, DWR & SAWPA, USGS
0
37.5
75
150
Miles
N
W
E
S

# Geology of Alluvial Fans

- **Alluvial fans form where mountain streams flow into valleys.**
- **Floods, debris floods and debris flows build alluvial fans and can pose risks to lives and property.**
- **Not all parts of alluvial fans are equally dangerous.**
- **Geologic hazards on alluvial fans change due to fires, storms, and earthquakes.**
- **Geologic mapping can help to identify hazardous areas and aid in developing sound landuse policies.**

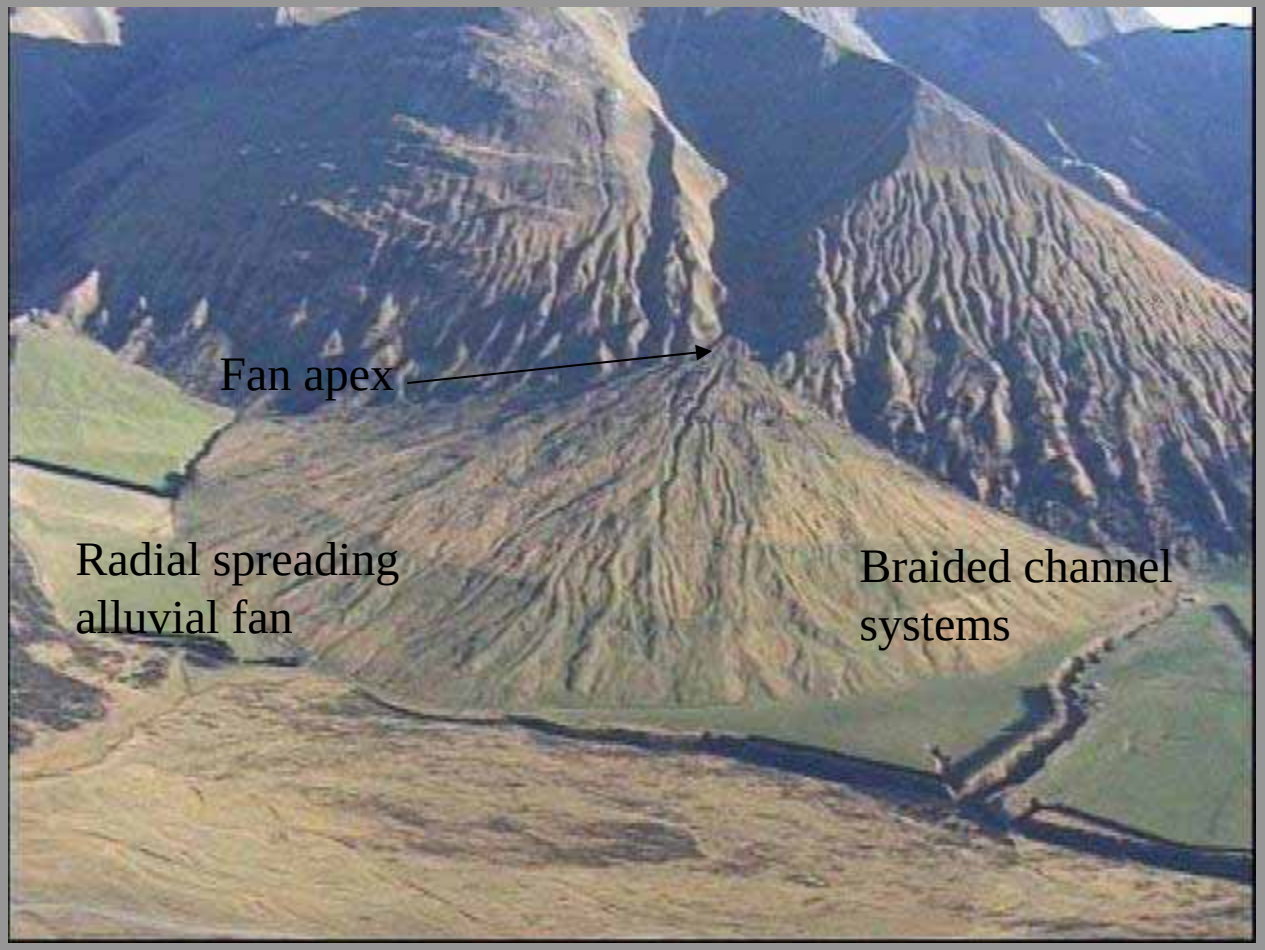
# Why Are Alluvial Fans Treated Differently?

- Direction of Flows not Always Predictable.
- More Severe Consequences of Flooding: Erosion, Debris Impact.
- California's Highest Growth Areas are in Counties with extensive Alluvial Fan Environments.

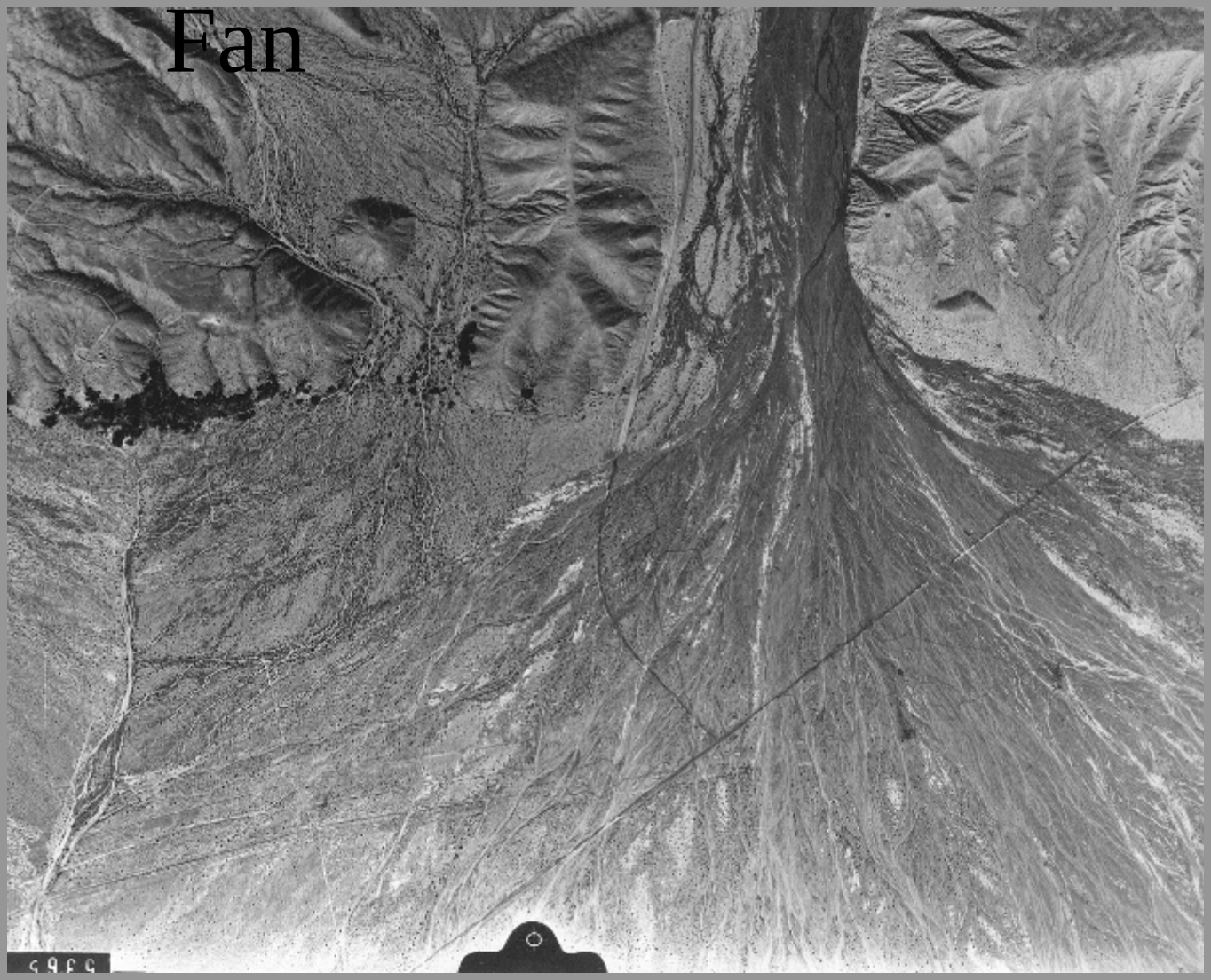
# What is “Alluvial Fan Flooding” ?

- A Flood Hazard where Flow Path Uncertainty is so Great, it cannot be ignored in characterizing flood risk.
- Historical Evidence of abrupt Erosion and Deposition.
- Elevation of Structures on Fill will not Mitigate the Flood Risk.

# What is an Alluvial Fan?



# Active Fan



## Magnesia Canyon in 1979


## Magnesia Canyon in 2006


Day Canyon and East Etiwanda
Canyon fans in 2006
ESRI

# Alluvial Fan Issues

## From an Ecological Perspective

- **Climate change – providing critical connectivity between lowlands and uplands**
- **Habitat for sensitive species**
- **Ecosystem processes and services:**
  - **sand delivery for dunes and beaches**
  - **aquifer recharge**
  - **flood control**
  - **nutrient and sediment transport for riparian habitats**
- **Cultural resources**
- **Recreation – trails and open space**

# Water Supply/Quality Impacts of Sediment-laden Flood Flows

- Groundwater is the source of more than 50% of the Southern California's drinking water
  - Much of this comes from rainwater percolated from the mountains
- Groundwater percolation basins are impacted by mud and rock-reducing recharge
- Millions of tons of cubic yards of ash are washed into creeks as far away as Orange County

# Flooded Recharge Basins

# Counting Natural Disaster Economic Impacts.

| | |
|---|---|
| **Losses** | • All direct and indirect costs. |
| **Costs** | • Losses that are reimbursed by insurance or government |
| **Direct Losses** | • Cost of physical damage (to structures/people) from event.<br>• Will exceed the costs. |
| **Indirect Losses** | • Temporary unemployment and business disruption. |

***Indirect losses likely to have a large impact on local economy because they are usually not reimbursed***

# Historical Flood Damages are Large.

**Flood damage counting**

- **Cannot separate out types and geographic area of floods.**
- **Damages would be higher with current development.**
- **Property damages and debris removal costs.**

**Current Dollar Costs**

- **(excludes 2003 damages)**

***Indirect costs of floods are not included and are likely large.***

# The Attractiveness of Alluvial Fans

- Residential development in cities seek locations that provide amenities and features.
- Views are a desirable feature and development along foothills are prime areas for high end neighborhoods.
- Alluvial fans offer a broad expanse of land with multiple lots.

# The Hidden Costs of Alluvial Fan Development

- In City and County Governments, Public Works agencies provide infrastructure maintenance support.
- In most local governments, funding for Public Works can be 5% to 10% of total General Fund.
- In contrast, Public Safety (Police and Fire) may take nearly 60% of General Fund.

# If considering development on fans…

- Need to recognize that after the developers have left, City / County is responsible for the facilities constructed.
- Designs for future developments should consider maintainability and loss prevention from debris flows.
- An ounce of prevention is worth a pound of cure.

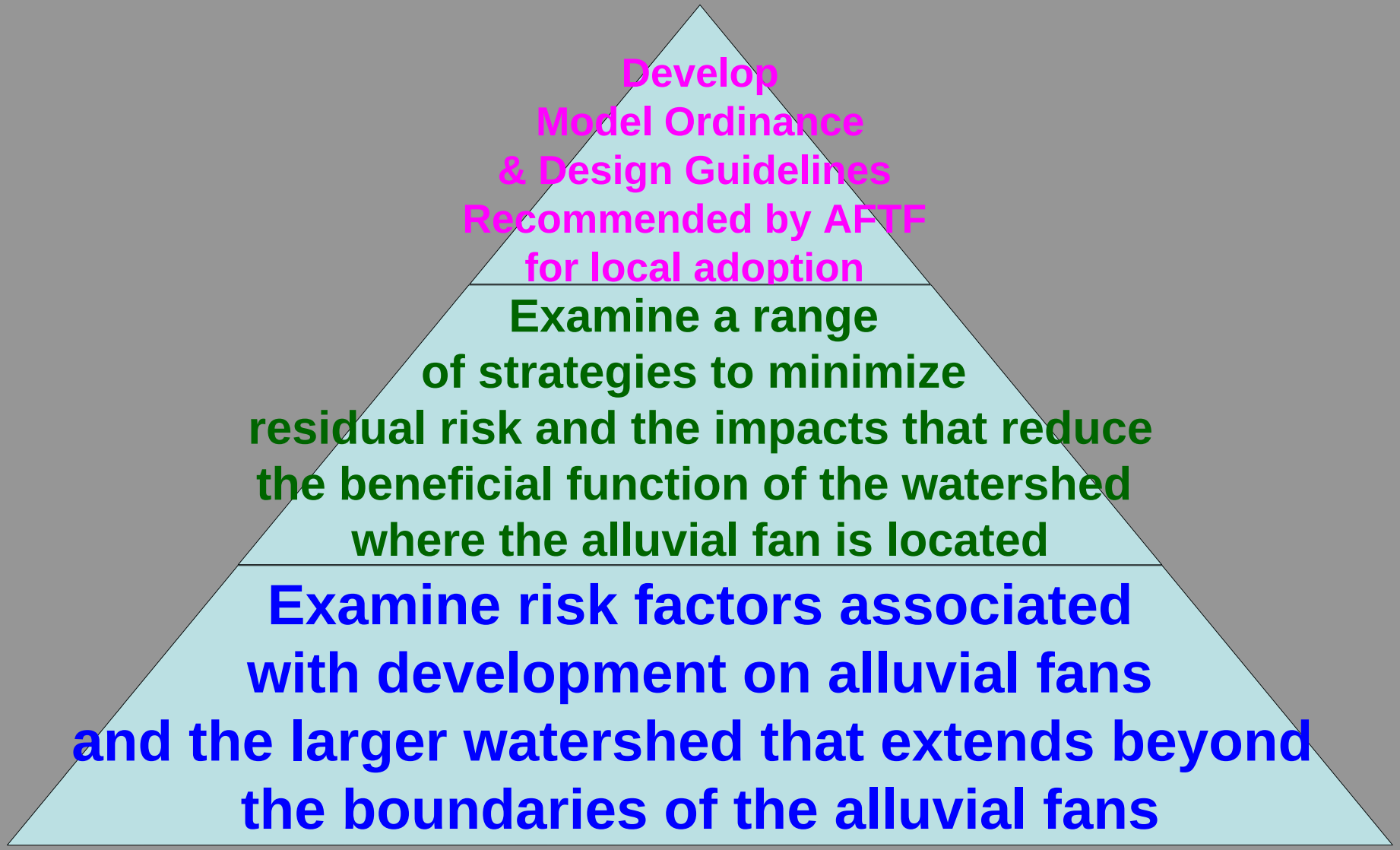
# Public Works Cleans It UP!

- While Police and Fire are the “sexy” functions in government, they don’t generally stick around to clean up the mud, debris and boulders after the event is over.
- Bulldozers, skip loaders, dump trucks, sweepers and lots of hand shovelling and brooming.

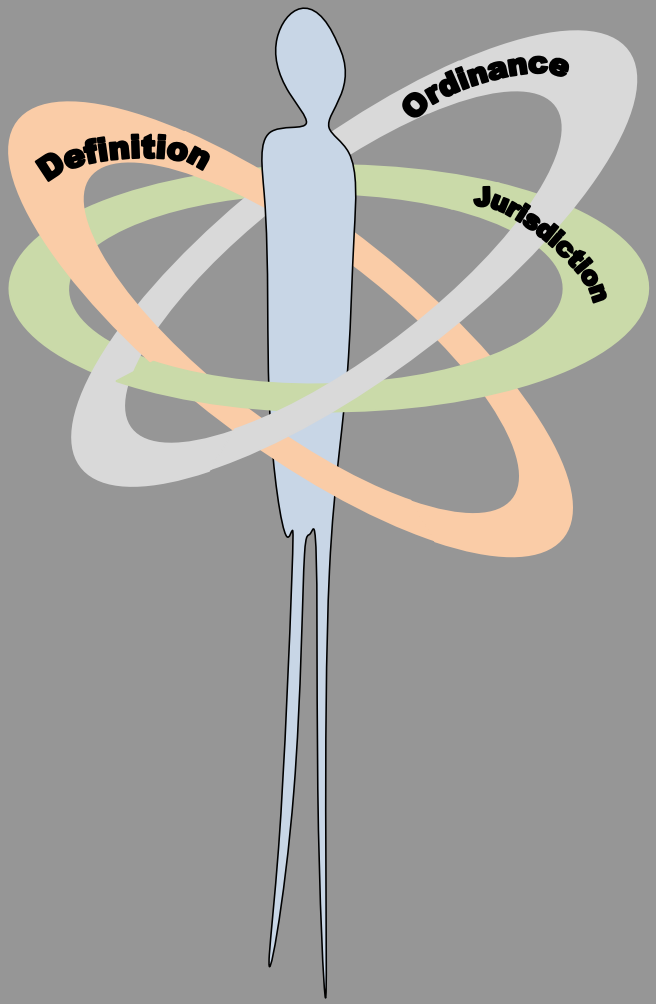
# Local Issues to Consider…

- What are best management practices for minimizing debris flows while balancing development.
- Funding for maintenance and restoration without counting on State and Federal agencies.
- Improve ability to quickly restore services and operations to pre-event condition for multiple storm events.

# Mission and Process of AFTF



Over time we collectively self impose all of these conditions




**Definitions** define geographies

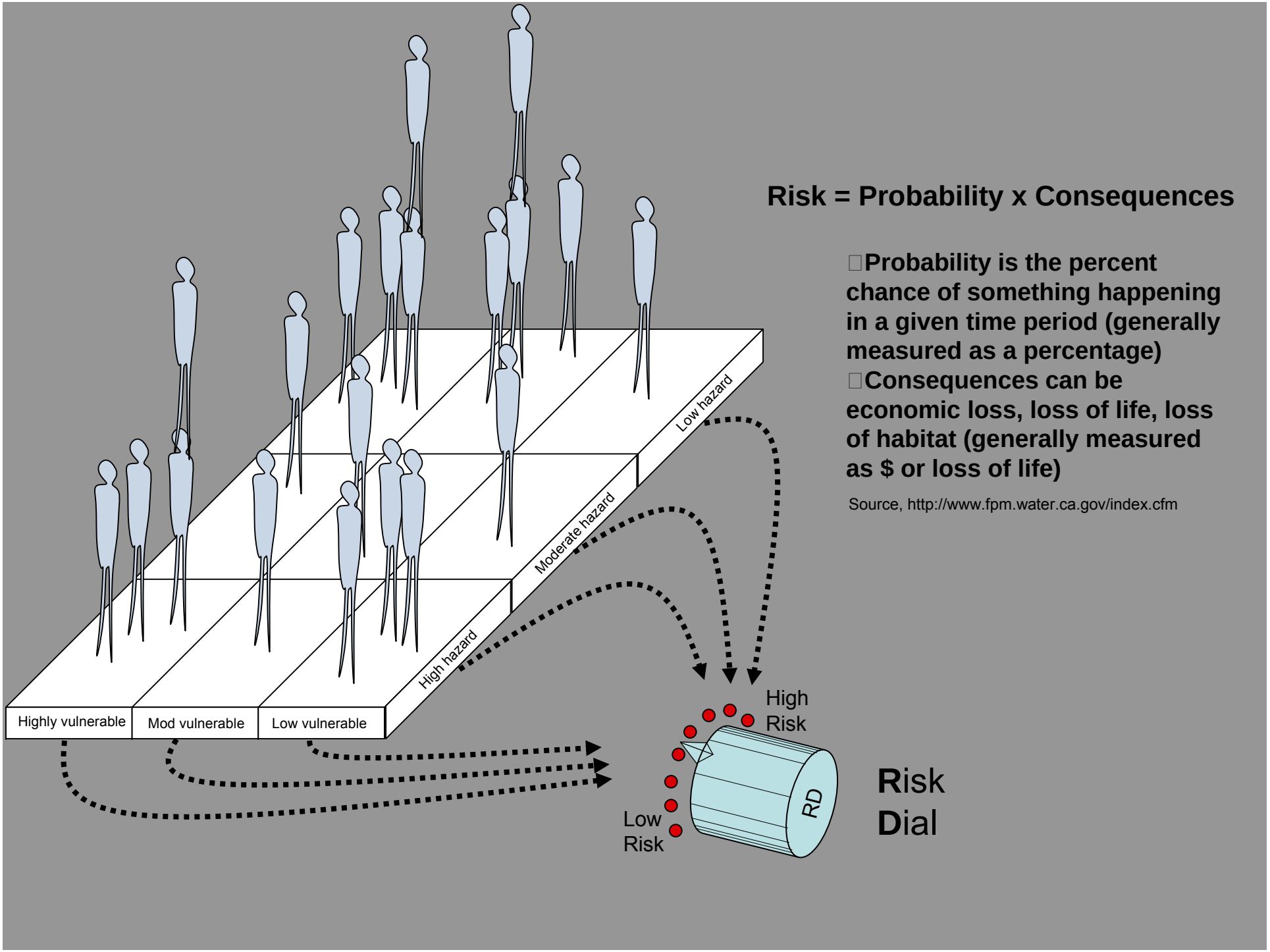
where are alluvial fans

**Jurisdictions** define enforcement

who makes and enforces the rules

**Ordinances** defined, are the rules

*Collectively, we have used our values*
*to shape these mechanisms*
*to determine our tolerance for risk*

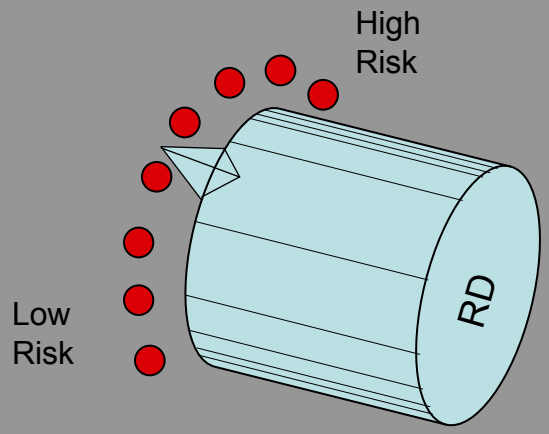



**Risk = Probability x Consequences**

- **Probability is the percent chance of something happening in a given time period (generally measured as a percentage)**
- **Consequences can be economic loss, loss of life, loss of habitat (generally measured as $ or loss of life)**

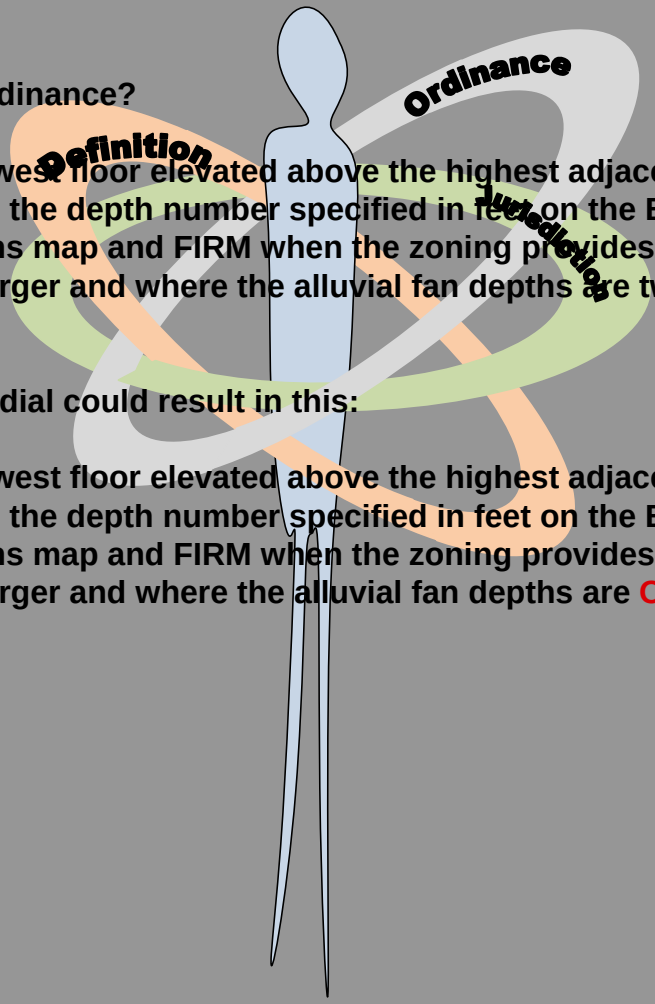
Source, http://www.fpm.water.ca.gov/index.cfm

# What changes when we collectively change this dial?




**Remember this ordinance?**

**“shall have the lowest floor elevated above the highest adjacent grade at least as high as the depth number specified in feet on the Borrego Valley Alluvial Fans map and FIRM when the zoning provides for one-half acre lots or larger and where the alluvial fan depths are two feet or less. ”**




**Lowering the risk dial could result in this:**

**“shall have the lowest floor elevated above the highest adjacent grade at least as high as the depth number specified in feet on the Borrego Valley Alluvial Fans map and FIRM when the zoning provides for one-half acre lots or larger and where the alluvial fan depths are ONE feet or less. ”**

# Mitigation Strategies

- **Avoidance**
- **Structural Flood Control Measures**
- **Multi-Objective Projects**
- **Remapping the actual hazard**

1904, San Bernardino

Notice alluvial fans and natural water ways in the unpopulated valley

2007, San Bernardino

Notice same alluvial fans with much higher population, and burned watershed

# Alluvial Fan Task Force Take Home Lessons

- Floods on Alluvial Fans Can be more Hazardous than for Rivers.
- High populations already exist in alluvial fan areas
- Alluvial fans are located in California's highest growth areas.
- Fan areas have unique ecological values
- Inactive fans can become active.
- Alluvial Fans can be Future High Hazards Areas in California